THURSDAY, MARCH 12, 1891.

HUYGENS AND HIS CORRESPONDENTS.

Œuvres Complètes de Christiaan Huygens. Tome Troisième, "Correspondance, 1660-61." (La Haye: Martinus Nijhoff, 1890.)

THE great edition of the works of Christian Huygens now in course of publication at the Hague (NATURE, vols. xxxviii. p. 103, xl. p. 591) continues to issue from the press, at a leisurely rate indeed, yet, all things considered, with creditable punctuality. A slight delay in the appearance of the third volume, now before us is fully accounted for by the discovery, in the National Library at Paris, of some documents bearing on the history of the pendulum-clock, which it was judged expedient to incorporate with it in the form of an appendix. Their interest is considerable, although their import be not subversive of received ideas. They serve to confirm the originality of Huygens, while illustrating the zeal displayed in contesting it. Such debates recur in every chapter of scientific history. They sometimes rouse impatience by their apparent triviality, but seldom fail, none the less, to bring out curious and suggestive facts. It is well when they are conducted with as little acrimony as in the present case. Huygens's brilliant success in applying the pendulum to the regulation of clocks in 1657 gave the signal for the raising of adverse claims to priority. Those of Galileo were the best founded; and they were championed by Prince Leopold de' Medici, brother of Ferdinand II., the reigning Grand Duke of Tuscany. Several of his letters on the subject to Boullaud are now published for the first time; he employed Viviani, a disciple of Galileo, to draw up a "statement of claim" on his behalf; and he sent to Paris, for communication to Huygens, a drawing of a model for a time-piece begun under Galileo's directions in the last year of his life (1641). Its reproduction (at p. 8 of the work under notice) shows indeed a pendulum connected with wheelwork, but no clock in the proper sense—means for continuing the motion, either in the shape of weights or springs, being totally absent. Galileo, in fact, was on the track of an invention which eluded him. He saw that the thing was to be done, but never quite achieved the doing of it. Old age and infirmity precluded him from this final triumph. He died, *re infectâ*, leaving his ideas to be perfected by his son Vincenzo, one of the "about to be's" of the world, whose dilatoriness, as usual in such cases, marred his ingenuity; his over-drawn account with time being at last peremptorily closed by the intervention of death. Huygens succeeded to the task ignorant of these previous attempts to deal with it; to which, indeed, attention was only directed by the effective completeness of his resulting discovery.

The present volume includes, besides supplementary matter, the correspondence of two years, 1660-61. Should the thirty-three still to be traversed prove equally productive, we may look forward to seventeen further volumes—making twenty in all—devoted to letters written by, to, or about the Dutch Archimedes. The practically endless vista of huge tomes thus opened out before us is no phantom of the imagination. There seems no reason to expect that the treasures of the Leyden archives will be found less rich as they are more deeply delved into. For the genius of Huygens never lapsed into inertness. Some of its most splendid fruits were gathered late in life. His career continued to the end closely interwoven with the seething scientific activity of his age; and his eagerness for information as to the fruits of that activity doubtless retaining its keen edge, his communications with the learned are not likely to have become less frequent or less copious. Their value, moreover, judging from the samples thus far printed, is so great as to render suppression or selection undesirable, so that we can only wonder at and admire the prodigious scale of this rising literary monument to the memory of a great man. And while bearing in mind that superfluity of information, as of other things, becomes at a certain point equivalent to penury, we willingly admit that the evils of extreme voluminousness are, in this stately publication, reduced to a minimum by the admirable care with which its contents are indexed and assorted.

The figure of Saturn continued to be the leading topic of astronomical discussion for several years after the publication of the Huygenian "System." The hypothesis there expounded still lacked some final touches of confirmation by fact; and its validity was accordingly regarded in many quarters as problematical. Experience alone could answer the question whether the predicted phases of the ring would manifest themselves as time went by; and observers eagerly scanned the ill-defined planetary contour displayed by their imperfect instruments for evidential *pros* and *cons*. Chief among them was the discoverer himself. He had described what was to be expected; it remained for him to announce what was to be seen; and he had the advantage over his contemporaries in the command of superior defining powers, both mental and telescopic. Eustachio Divini, it is true, was then popularly supposed to "hold the field" in optical art; yet his best glasses, favoured by the clear Roman air, still exhibited the "triple planet" under the aspect it had assumed to Galileo, as a globe with two detached spherical appendages. He naturally regarded his own observations as conclusive; but his "Brevis Annotatio," designed for the annihilation of a fictitious ringed Saturn, served only to demonstrate their deceptiveness; and Huygens, in his "Brevis Assertio Systematis Saturni," made a triumphant reply.

The Accademia del Cimento from the first unanimously supported him. At Florence it was said, "tutti erano Hugeniani." Borelli, less prejudiced, or better optically armed, than Divini, succeeded in tracing the connection of the ansæ with the disk; and a model was constructed of the strange Saturnian machine, by which, for the special benefit of Prince Leopold, all its varying appearances, well or ill observed in the sky, were experimentally and convincingly reproduced. Premature speculations as to the nature of the ring, indulged in, among others, by Magalotti and Roberval, made it the result of condensed vaporous exhalations from the body of the planet; while Neuræus recognized in it a unique contrivance for rendering habitable an otherwise desolate world at the confines of the solar system. The bizarre idea of its composition like a lens out of some highly refractive

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material enabling it to concentrate light and heat upon an underlying zone, thereby brought up to the terrestrial standard of comfortable accommodation for living beings, appeared then scarcely more extravagant than any other supposition regarding a structure of which the existence, antecedently to proof, might well have been thought incredible. Fine distinctions of probability vanished in the presence of so astounding a specimen of celestial workmanship.

An imperfect anticipation of "this kind of Saturn was hatched" (it is curious to learn) early in 1658, at White-Waltham, in Berkshire, by the combined exertions of Sir Christopher Wren and Sir Paul Neile. An elliptical "corona" was fitted to the planetary globe, meeting it at two places, and rotating with it once in its period of revolution round the sun, on an axis coinciding with the plane of that revolution. Thus, after a fashion, the observed phases were accounted for; but the superiority of the Huygenian *rationale*, divulged in the following year, was perceived by none more clearly than by Wren himself; and he wisely allowed his own abortive attempt to sink into quasi-oblivion. The paper embodying it is now printed in full (p. 419), accompanied by drawings testifying very creditably to the skill of early English opticians.

Huygens was the first to make definite observations of the markings on Mars. Some of his drawings have even proved available in the most recent determination of the planet's rotation, roughly estimated by him, from his views of the Kaiser Sea, November 28 and 30, and December 1, 1659, to occur in a period of twenty-four hours. The desire to confirm a discovery which would have been the earliest of its kind quickened his zeal for the further improvement of telescopes. The main obstacle lay, he thought, in the defective quality of the glass then fabricated. And the best, which was procured from Venice, was certainly bad, judging from the collection of Huygenian lenses preserved at Leyden (Kaiser, *Astr. Nach.*, No. 592). Nor did his tubeless telescopes, when actually brought into operation, realize all that was expected from them. Concurrent evils outweighed their theoretical superiority. The disk of Mars was, however, measured by Huygens with remarkable accuracy on December 25, 1659, by means of a metal slip, of graduated width, inserted at the telescopic focus. This was the first Continental example of the use of a micrometer.

An amusing glimpse behind the scenes of pseudo-scientific life in the seventeenth century is afforded by some communications included in the present volume relative to the horoscope of one of the Princesses of Orange. Huygens was the intermediary; Boullaud the prophet, whose dignity as an interpreter of mystic influences contrasts ludicrously with his childish petition for an "Indian jewel" as the guerdon of his services. On both sides, too, there is evidence of failing faith. Huygens, apprehensive of a fiasco if the enjoined secrecy were observed as to the name and quality of the lady, imparted them, under the rose, to an astrologer who had at least the merit of choosing a low level for his pretensions. He made no claim to the divination of particular circumstances. "Temperaments" only, in his opinion, were rained down, according to the rules of science, from the skies; and temperaments are vague entities, intangible, undefinable, defiant of positive affirmations or denials; to say nothing of the saving possibility of their lying latent for any convenient length of time. The horoscope of Albertina Agnes, Princess of Nassau, was, then, at any rate safe from confutation by facts.

In the spring of 1661, Huygens visited London. He was, however, far from sharing his brother Ludovic's enthusiasm for the city by the Thames. The smell of smoke there he found "insupportable," and concluded to be insalubrious; mean architecture, narrow and ill-paved streets, unstable dwelling-houses, shabby public gardens, constituted the chief part of his impressions. The lower orders struck him as melancholy, the upper classes as naturally unsocial, their affability to strangers notwithstanding, the women as deficient in conversational charm, and falling a long way behind their French sisters in sprightliness; and he echoed the hope that an advance in refinement of manners would ensue upon the re-establishment of the Court. He was presented at Windsor to the King, whom he found somewhat curt and pre-occupied; but he left it to Pepys to chronicle the "brave sight" of the coronation in Westminster Abbey on May 3, choosing for his own share the competing celestial spectacle of Mercury's transit across the sun. It was the first phenomenon of the kind which had been at all generally observed, and Huygens watched its progress from Long Acre with one of Reeves's excellent telescopes. Some of his own were set up in the garden behind Whitehall, and occasionally served to display Saturnian marvels to the gaze of the Duke and Duchess of York. The method of their fabrication was a secret until Huygens gratified the Royal Society with its disclosure; and he was, on the other hand, deeply interested in the experiments on vacua exhibited before him at Gresham College. The hospitality and politeness, indeed, with which he was received both in public and private, did not fail to win his acknowledgments; nor could he remain insensible to the high capacity of many of his learned entertainers, "most of whom," he added, "had travelled in France and elsewhere." Unmistakably, he had by this time fallen under the spell of our neighbours' subtle charm. French had become a second native language to him, and, although he acquired enough English to make himself understood when occasion required, he did not prosecute the study very zealously. Nor was it necessary. His correspondence with Sir Robert Moray, Boyle, and Oldenburg, was carried on in French; Wallis used Latin by preference; Boyle's new tracts were promptly conveyed into French or Latin. Even his Dutch vernacular was in a measure discarded by the astronomer of the Hague in favour of more cosmopolitan tongues. Insensibly and inevitably he had grown beyond the range of a single country. He belonged henceforth primarily to Europe; only secondarily, and by a tie which was soon to be still further loosened, to Holland.

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FORCE AND DETERMINISM.

The Philosophical Basis of Evolution. By James Croll, LL.D., F.R.S. (London: Edward Stanford, 1891.)

AGAIN and again is the physicist, in the course of his researches, brought face to face with philosophical questions. It then depends upon the bent and bias of

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